WE CLAIM:

1. In a process for the separation of liquefied natural gas containing methane and heavier hydrocarbon components, in which process

(a) said liquefied natural gas stream is supplied to a fractionation column in one or more feed streams; and

(b) said liquefied natural gas is fractionated into a more volatile fraction containing a major portion of said methane and a relatively less volatile fraction containing a major portion of said heavier hydrocarbon components;

the improvement wherein

(1) a distillation stream is withdrawn from an upper region of said fractionation column, is cooled sufficiently to partially condense it, and is thereafter separated to form said more volatile fraction containing a major portion of said methane and a reflux stream;

(2) said reflux stream is supplied to said fractionation column at a top column feed position;

(3) said liquefied natural gas stream is heated to supply at least a portion of said cooling of said distillation stream and thereafter divided into at least a first stream and a second stream;

(4) said first stream is supplied to said fractionation column at an upper mid-column feed position;

(5) said second stream is heated sufficiently to vaporize at least a portion of it and thereafter supplied to said fractionation column at a lower mid-column feed position; and

(6) the quantity and temperature of said reflux stream and the temperatures of said feeds to said fractionation column are effective to maintain the overhead temperature of said fractionation column at a temperature whereby the major portion of said heavier hydrocarbon components is recovered in said relatively less volatile fraction.

2. In a process for the separation of liquefied natural gas containing methane and heavier hydrocarbon components, in which process

(a) said liquefied natural gas stream is supplied to a fractionation column in one or more feed streams; and

(b) said liquefied natural gas is fractionated into a more volatile fraction containing a major portion of said methane and a relatively less volatile fraction containing a major portion of said heavier hydrocarbon components;

the improvement wherein

(1) a contacting device operating at a pressure higher than the pressure of said fractionation column is provided to further fractionate said liquefied natural gas;

(2) a distillation stream is withdrawn from an upper region of said contacting device, cooled sufficiently to partially condense it, and thereafter

separated to form said more volatile fraction containing a major portion of said methane and a reflux stream;

(3) said reflux stream is supplied to said contacting device at a top column feed position;

(4) said liquefied natural gas stream is heated sufficiently to vaporize at least a portion of it, supplying thereby at least a portion of said cooling of said distillation stream;

(5) said heated liquefied natural gas stream is directed into said contacting device, wherein said distillation stream and a liquid stream are formed and separated;

(6) said liquid stream is directed into said fractionation column wherein said stream is separated into a vapor stream and said relatively less volatile fraction containing a major portion of said heavier hydrocarbon components;

(7) said vapor stream is compressed to higher pressure and thereafter supplied to said contacting device at a lower column feed point; and

(8) the quantity and temperature of said reflux stream and the temperatures of said feeds to said contacting device and said fractionation column are effective to maintain the overhead temperatures of said contacting device and said fractionation column at temperatures whereby the major portion of said heavier hydrocarbon components is recovered in said relatively less volatile fraction.

3. In a process for the separation of liquefied natural gas containing methane and heavier hydrocarbon components, in which process

(a) said liquefied natural gas stream is supplied to a fractionation column in one or more feed streams; and

(b) said liquefied natural gas is fractionated into a more volatile fraction containing a major portion of said methane and a relatively less volatile fraction containing a major portion of said heavier hydrocarbon components;

the improvement wherein

(1) a contacting device operating at a pressure higher than the pressure of said fractionation column is provided to further fractionate said liquefied natural gas;

(2) a distillation stream is withdrawn from an upper region of said contacting device, cooled sufficiently to partially condense it, and thereafter separated to form said more volatile fraction containing a major portion of said methane and a reflux stream;

(3) said reflux stream is supplied to said contacting device at a top column feed position;

(4) said liquefied natural gas stream is heated to supply at least a portion of said cooling of said distillation stream and thereafter divided into at least a first stream and a second stream;

(5) said first stream is supplied to said contacting device at a mid-column feed position;

(6) said second stream is heated sufficiently to vaporize at least a portion of it and thereafter supplied to said contacting device at a lower column feed point, wherein said distillation stream and a liquid stream are formed and separated;

(7) said liquid stream is directed into said fractionation column wherein said stream is separated into a vapor stream and said relatively less volatile fraction containing a major portion of said heavier hydrocarbon components;

(8) said vapor stream is compressed to higher pressure and thereafter supplied to said contacting device at a lower column feed point; and

(9) the quantity and temperature of said reflux stream and the temperatures of said feeds to said contacting device and said fractionation column are effective to maintain the overhead temperatures of said contacting device and said fractionation column at temperatures whereby the major portion of said heavier hydrocarbon components is recovered in said relatively less volatile fraction.

4. In a process for the separation of liquefied natural gas containing methane and heavier hydrocarbon components, in which process

(a) said liquefied natural gas stream is supplied to a fractionation column in one or more feed streams; and

(b) said liquefied natural gas is fractionated into a more volatile fraction containing a major portion of said methane and a relatively less volatile fraction containing a major portion of said heavier hydrocarbon components;

the improvement wherein

(1) a contacting device operating at a pressure higher than the pressure of said fractionation column is provided to further fractionate said liquefied natural gas;

(2) a distillation stream is withdrawn from an upper region of said contacting device, cooled sufficiently to partially condense it, and thereafter separated to form said more volatile fraction containing a major portion of said methane and a reflux stream;

(3) said reflux stream is supplied to said contacting device at a top column feed position;

(4) said liquefied natural gas stream is heated sufficiently to vaporize at least a portion of it, supplying thereby at least a portion of said cooling of said distillation stream;

(5) said heated liquefied natural gas stream is directed into said contacting device, wherein said distillation stream and a liquid stream are formed and separated;

(6) said liquid stream is directed into said fractionation column wherein said stream is separated into a vapor stream and said relatively less volatile fraction containing a major portion of said heavier hydrocarbon components;

(7) said vapor stream is cooled to substantial condensation;

(8) said substantially condensed stream is pumped to higher pressure, heated sufficiently to vaporize at least a portion of it, and thereafter supplied to said contacting device at a lower column feed point; and

(9) the quantity and temperature of said reflux stream and the temperatures of said feeds to said contacting device and said fractionation column are effective to maintain the overhead temperatures of said contacting device and said fractionation column at temperatures whereby the major portion of said heavier hydrocarbon components is recovered in said relatively less volatile fraction.

5. In a process for the separation of liquefied natural gas containing methane and heavier hydrocarbon components, in which process

(a) said liquefied natural gas stream is supplied to a fractionation column in one or more feed streams; and

(b) said liquefied natural gas is fractionated into a more volatile fraction containing a major portion of said methane and a relatively less volatile fraction containing a major portion of said heavier hydrocarbon components;

the improvement wherein

(1) a contacting device operating at a pressure higher than the pressure of said fractionation column is provided to further fractionate said liquefied natural gas;

(2) a distillation stream is withdrawn from an upper region of said contacting device, cooled sufficiently to partially condense it, and thereafter separated to form said more volatile fraction containing a major portion of said methane and a reflux stream;

(3) said reflux stream is supplied to said contacting device at a top column feed position;

(4) said liquefied natural gas stream is heated to supply at least a portion of said cooling of said distillation stream and thereafter divided into at least a first stream and a second stream;

(5) said first stream is supplied to said contacting device at a mid-column feed position;

(6) said second stream is heated sufficiently to vaporize at least a portion of it and thereafter supplied to said contacting device at a lower column feed point, wherein said distillation stream and a liquid stream are formed and separated;

(7) said liquid stream is directed into said fractionation column wherein said stream is separated into a vapor stream and said relatively less volatile fraction containing a major portion of said heavier hydrocarbon components;

(8) said vapor stream is cooled to substantial condensation;

(9) said substantially condensed stream is pumped to higher pressure, heated sufficiently to vaporize at least a portion of it, and thereafter supplied to said contacting device at a lower column feed point; and

(10) the quantity and temperature of said reflux stream and the temperatures of said feeds to said contacting device and said fractionation column are effective to maintain the overhead temperatures of said contacting device and said fractionation column at temperatures whereby the major portion of said heavier hydrocarbon components is recovered in said relatively less volatile fraction.

6. In a process for the separation of liquefied natural gas containing methane and heavier hydrocarbon components, in which process

(a) said liquefied natural gas stream is supplied to a fractionation column in one or more feed streams; and

(b) said liquefied natural gas is fractionated into a more volatile fraction containing a major portion of said methane and a relatively less volatile fraction containing a major portion of said heavier hydrocarbon components;

the improvement wherein

(1) a contacting device operating at a pressure higher than the pressure of said fractionation column is provided to further fractionate said liquefied natural gas;

(2) a distillation stream is withdrawn from an upper region of said contacting device, cooled sufficiently to partially condense it, and thereafter separated to form said more volatile fraction containing a major portion of said methane and a reflux stream;

(3) said reflux stream is supplied to said contacting device at a top column feed position;

(4) said liquefied natural gas stream is heated sufficiently to vaporize at least a portion of it, supplying thereby at least a portion of said cooling of said distillation stream;

(5) said heated liquefied natural gas stream is directed into said contacting device, wherein said distillation stream and a first liquid stream are formed and separated;

(6) said first liquid stream is directed into said fractionation column wherein said stream is separated into a first vapor stream and said relatively less volatile fraction containing a major portion of said heavier hydrocarbon components;

(7) said first vapor stream is cooled sufficiently to partially condense it and is thereafter separated to form a second vapor stream and a second liquid stream;

(8) said second vapor stream is compressed to higher pressure and thereafter supplied to said contacting device at a lower column feed point;

(9) said second liquid stream is pumped to higher pressure, heated sufficiently to vaporize at least a portion of it, and thereafter supplied to said contacting device at a lower column feed point; and

(10) the quantity and temperature of said reflux stream and the temperatures of said feeds to said contacting device and said fractionation column are effective to maintain the overhead temperatures of said contacting device and said fractionation column at temperatures whereby the major portion of said heavier hydrocarbon components is recovered in said relatively less volatile fraction.

7. In a process for the separation of liquefied natural gas containing methane and heavier hydrocarbon components, in which process

(a) said liquefied natural gas stream is supplied to a fractionation column in one or more feed streams; and

(b) said liquefied natural gas is fractionated into a more volatile fraction containing a major portion of said methane and a relatively less volatile fraction containing a major portion of said heavier hydrocarbon components;

the improvement wherein

(1) a contacting device operating at a pressure higher than the pressure of said fractionation column is provided to further fractionate said liquefied natural gas;

(2) a distillation stream is withdrawn from an upper region of said contacting device, cooled sufficiently to partially condense it, and thereafter separated to form said more volatile fraction containing a major portion of said methane and a reflux stream;

(3) said reflux stream is supplied to said contacting device at a top column feed position;

(4) said liquefied natural gas stream is heated to supply at least a portion of said cooling of said distillation stream and thereafter divided into at least a first stream and a second stream;

(5) said first stream is supplied to said contacting device at a mid-column feed position;

(6) said second stream is heated sufficiently to vaporize at least a portion of it and thereafter supplied to said contacting device at a lower column feed point, wherein said distillation stream and a first liquid stream are formed and separated;

(7) said first liquid stream is directed into said fractionation column wherein said stream is separated into a first vapor stream and said relatively less volatile fraction containing a major portion of said heavier hydrocarbon components;

(8) said first vapor stream is cooled sufficiently to partially condense it and is thereafter separated to form a second vapor stream and a second liquid stream;

(9) said second vapor stream is compressed to higher pressure and thereafter supplied to said contacting device at a lower column feed point;

(10) said second liquid stream is pumped to higher pressure, heated sufficiently to vaporize at least a portion of it, and thereafter supplied to said contacting device at a lower column feed point; and

(11) the quantity and temperature of said reflux stream and the temperatures of said feeds to said contacting device and said fractionation column are effective to maintain the overhead temperatures of said contacting device and said fractionation column at temperatures whereby the major portion of said heavier hydrocarbon components is recovered in said relatively less volatile fraction.

8. In a process for the separation of liquefied natural gas containing methane and heavier hydrocarbon components, in which process

(a) said liquefied natural gas stream is supplied to a fractionation column in one or more feed streams; and

(b) said liquefied natural gas is fractionated into a more volatile fraction containing a major portion of said methane and a relatively less volatile fraction containing a major portion of said heavier hydrocarbon components;

the improvement wherein

(1) a contacting device operating at a pressure higher than the pressure of said fractionation column is provided to further fractionate said liquefied natural gas;

(2) a distillation stream is withdrawn from an upper region of said contacting device, cooled sufficiently to partially condense it, and thereafter separated to form said more volatile fraction containing a major portion of said methane and a reflux stream;

(3) said reflux stream is supplied to said contacting device at a top column feed position;

(4) said liquefied natural gas stream is heated sufficiently to vaporize at least a portion of it, supplying thereby at least a portion of said cooling of said distillation stream;

(5) said heated liquefied natural gas stream is directed into said contacting device, wherein said distillation stream and a first liquid stream are formed and separated;

(6) said first liquid stream is directed into said fractionation column wherein said stream is separated into a first vapor stream and said relatively less volatile fraction containing a major portion of said heavier hydrocarbon components;

(7) said first vapor stream is cooled sufficiently to partially condense it and is thereafter separated to form a second vapor stream and a second liquid stream;

(8) said second vapor stream is compressed to higher pressure;

(9) said second liquid stream is pumped to higher pressure and heated sufficiently to vaporize at least a portion of it;

(10) said compressed second vapor stream and said heated pumped second liquid stream are combined to form a combined stream and said combined stream is thereafter supplied to said contacting device at a lower column feed point; and

(11) the quantity and temperature of said reflux stream and the temperatures of said feeds to said contacting device and said fractionation column are effective to maintain the overhead temperatures of said contacting device and said fractionation column at temperatures whereby the major portion of said heavier hydrocarbon components is recovered in said relatively less volatile fraction.

9. In a process for the separation of liquefied natural gas containing methane and heavier hydrocarbon components, in which process

(a) said liquefied natural gas stream is supplied to a fractionation column in one or more feed streams; and

(b) said liquefied natural gas is fractionated into a more volatile fraction containing a major portion of said methane and a relatively less volatile fraction containing a major portion of said heavier hydrocarbon components;

the improvement wherein

(1) a contacting device operating at a pressure higher than the pressure of said fractionation column is provided to further fractionate said liquefied natural gas;

(2) a distillation stream is withdrawn from an upper region of said contacting device, cooled sufficiently to partially condense it, and thereafter separated to form said more volatile fraction containing a major portion of said methane and a reflux stream;

(3) said reflux stream is supplied to said contacting device at a top column feed position;

(4) said liquefied natural gas stream is heated to supply at least a portion of said cooling of said distillation stream and thereafter divided into at least a first stream and a second stream;

(5) said first stream is supplied to said contacting device at a mid-column feed position;

(6) said second stream is heated sufficiently to vaporize at least a portion of it and thereafter supplied to said contacting device at a lower column feed point, wherein said distillation stream and a first liquid stream are formed and separated;

(7) said first liquid stream is directed into said fractionation column wherein said stream is separated into a first vapor stream and said relatively less volatile fraction containing a major portion of said heavier hydrocarbon components;

(8) said first vapor stream is cooled sufficiently to partially condense it and is thereafter separated to form a second vapor stream and a second liquid stream;

(9) said second vapor stream is compressed to higher pressure;

(10) said second liquid stream is pumped to higher pressure and heated sufficiently to vaporize at least a portion of it;

(11) said compressed second vapor stream and said heated pumped second liquid stream are combined to form a combined stream and said combined stream is thereafter supplied to said contacting device at a lower column feed point; and

(12) the quantity and temperature of said reflux stream and the temperatures of said feeds to said contacting device and said fractionation column are effective to maintain the overhead temperatures of said contacting device and said fractionation column at temperatures whereby the major portion of said heavier hydrocarbon components is recovered in said relatively less volatile fraction.

10. The improvement according to claim 2 wherein said compressed vapor stream is cooled and thereafter supplied to said contacting device at a lower column feed point.

11. The improvement according to claim 3 wherein said compressed vapor stream is cooled and thereafter supplied to said contacting device at a lower column feed point.

12. The improvement according to claim 6 wherein said compressed second vapor stream is cooled and thereafter supplied to said contacting device at a lower column feed point.

13. The improvement according to claim 7 wherein said compressed second vapor stream is cooled and thereafter supplied to said contacting device at a lower column feed point.

14. The improvement according to claim 8 wherein said compressed second vapor stream is cooled and thereafter combined with said heated pumped second liquid stream to form said combined stream.

15. The improvement according to claim 9 wherein said compressed second vapor stream is cooled and thereafter combined with said heated pumped second liquid stream to form said combined stream.

16. The improvement according to claim 2 wherein said vapor stream is heated, compressed to higher pressure, cooled, and thereafter supplied to said contacting device at a lower column feed point.

17. The improvement according to claim 3 wherein said vapor stream is heated, compressed to higher pressure, cooled, and thereafter supplied to said contacting device at a lower column feed point.

18. The improvement according to claim 6 wherein said second vapor stream is heated, compressed to higher pressure, cooled, and thereafter supplied to said contacting device at a lower column feed point.

19. The improvement according to claim 7 wherein said second vapor stream is heated, compressed to higher pressure, cooled, and thereafter supplied to said contacting device at a lower column feed point.

20. The improvement according to claim 8 wherein said second vapor stream is heated, compressed to higher pressure, cooled, and thereafter combined with said heated pumped second liquid stream to form said combined stream.

21. The improvement according to claim 9 wherein said second vapor stream is heated, compressed to higher pressure, cooled, and thereafter combined with said heated pumped second liquid stream to form said combined stream.

22. The improvement according to claim 1 wherein said distillation stream is cooled sufficiently to partially condense it in a dephlegmator and concurrently separated to form said more volatile fraction containing a major portion of said methane and said reflux stream, whereupon said reflux stream flows from the dephlegmator to the top fractionation stage of said fractionation column.

23. The improvement according to claim 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, or 21 wherein said distillation stream is cooled sufficiently to partially condense it in a dephlegmator and concurrently separated to form said more volatile fraction containing a major portion of said methane and said reflux stream, whereupon said reflux stream flows from the dephlegmator to the top fractionation stage of said contacting device.

24. In an apparatus for the separation of liquefied natural gas containing methane and heavier hydrocarbon components, in said apparatus there being

(a) supply means to supply said liquefied natural gas to a fractionation column in one or more feed streams; and

(b) a fractionation column connected to said supply means to receive said liquefied natural gas and fractionate it into a more volatile fraction containing a major portion of said methane and a relatively less volatile fraction containing a major portion of said heavier hydrocarbon components;

the improvement wherein said apparatus includes

(1) withdrawing means connected to an upper region of said fractionation column to withdraw a distillation stream;

(2) first heat exchange means connected to said withdrawing means to receive said distillation stream and cool it sufficiently to partially condense it;

(3) separation means connected to said first heat exchange means to receive said partially condensed distillation stream and separate it into said more volatile fraction containing a major portion of said methane and a reflux stream, said separation means being further connected to said fractionation column to supply said reflux stream to said fractionation column at a top column feed position;

(4) first heat exchange means further connected to said supply means to receive said liquefied natural gas and heat it, thereby supplying at least a portion of said cooling of said distillation stream;

(5) dividing means connected to said first heat exchange means to receive said heated liquefied natural gas and divide it into at least a first stream and a

second stream, said dividing means being further connected to said fractionation column to supply said first stream at an upper mid-column feed position;

(6) second heat exchange means connected to said dividing means to receive said second stream and heat it sufficiently to vaporize at least a portion of it, said second heat exchange means being further connected to said fractionation column to supply said heated second stream at a lower mid-column feed position; and

(7) control means adapted to regulate the quantity and temperature of said reflux stream and the temperatures of said feed streams to said fractionation column to maintain the overhead temperature of said fractionation column at a temperature whereby the major portion of said heavier hydrocarbon components is recovered in said relatively less volatile fraction.

25. In an apparatus for the separation of liquefied natural gas containing methane and heavier hydrocarbon components, in said apparatus there being

(a) supply means to supply said liquefied natural gas to a fractionation column in one or more feed streams; and

(b) a fractionation column connected to said supply means to receive said liquefied natural gas and fractionate it into a more volatile fraction containing a major portion of said methane and a relatively less volatile fraction containing a major portion of said heavier hydrocarbon components;

the improvement wherein said apparatus includes

(1) contacting and separating means operating at a pressure higher than the pressure of said fractionation column, said contacting and separating means including separating means to separate resultant vapors and liquids after contact;

(2) withdrawing means connected to an upper region of said contacting and separating means to withdraw a distillation stream;

(3) first heat exchange means connected to said withdrawing means to receive said distillation stream and cool it sufficiently to partially condense it;

(4) separation means connected to said first heat exchange means to receive said partially condensed distillation stream and separate it into said more volatile fraction containing a major portion of said methane and a reflux stream, said separation means being further connected to said contacting and separating means to supply said reflux stream to said contacting and separating means at a top column feed position;

(5) first heat exchange means further connected to said supply means to receive said liquefied natural gas and heat it, thereby supplying at least a portion of said cooling of said distillation stream;

(6) second heat exchange means connected to said first heat exchange means to receive said heated liquefied natural gas and further heat it sufficiently to vaporize at least a portion of it;

(7) said contacting and separating means connected to receive said further heated liquefied natural gas, whereupon said distillation stream and a liquid stream are formed and separated;

(8) said fractionation column connected to receive said liquid stream and separate it into a vapor stream and said relatively less volatile fraction containing a major portion of said heavier hydrocarbon components;

(9) compressing means connected to said fractionation column to receive said vapor stream and compress it to higher pressure, said compressing means being further connected to said contacting and separating means to supply said compressed vapor stream at a lower column feed point; and

(10) control means adapted to regulate the quantity and temperature of said reflux stream and the temperatures of said feed streams to said contacting and separating means and said fractionation column to maintain the overhead temperatures of said contacting and separating means and said fractionation column at temperatures whereby the major portion of said heavier hydrocarbon components is recovered in said relatively less volatile fraction.

26. In an apparatus for the separation of liquefied natural gas containing methane and heavier hydrocarbon components, in said apparatus there being

(a) supply means to supply said liquefied natural gas to a fractionation column in one or more feed streams; and

(b) a fractionation column connected to said supply means to receive said liquefied natural gas and fractionate it into a more volatile fraction containing a major portion of said methane and a relatively less volatile fraction containing a major portion of said heavier hydrocarbon components;

the improvement wherein said apparatus includes

(1) contacting and separating means operating at a pressure higher than the pressure of said fractionation column, said contacting and separating means including separating means to separate resultant vapors and liquids after contact;

(2) withdrawing means connected to an upper region of said contacting and separating means to withdraw a distillation stream;

(3) first heat exchange means connected to said withdrawing means to receive said distillation stream and cool it sufficiently to partially condense it;

(4) separation means connected to said first heat exchange means to receive said partially condensed distillation stream and separate it into said more volatile fraction containing a major portion of said methane and a reflux stream, said separation means being further connected to said contacting and separating means to supply said reflux stream to said contacting and separating means at a top column feed position;

(5) first heat exchange means further connected to said supply means to receive said liquefied natural gas and heat it, thereby supplying at least a portion of said cooling of said distillation stream;

(6) dividing means connected to said first heat exchange means to receive said heated liquefied natural gas and divide it into at least a first stream and a second stream;

(7) second heat exchange means connected to said dividing means to receive said second stream and heat it sufficiently to vaporize at least a portion of it;

(8) said contacting and separating means connected to receive said first stream at a mid-column feed position and said heated second stream at a lower column feed point, whereupon said distillation stream and a liquid stream are formed and separated;

(9) said fractionation column connected to receive said liquid stream and separate it into a vapor stream and said relatively less volatile fraction containing a major portion of said heavier hydrocarbon components;

(10) compressing means connected to said fractionation column to receive said vapor stream and compress it to higher pressure, said compressing means being further connected to said contacting and separating means to supply said compressed vapor stream at a lower column feed point; and

(11) control means adapted to regulate the quantity and temperature of said reflux stream and the temperatures of said feed streams to said contacting and separating means and said fractionation column to maintain the overhead temperatures of said contacting and separating means and said fractionation column at temperatures whereby the major portion of said heavier hydrocarbon components is recovered in said relatively less volatile fraction.

27. In an apparatus for the separation of liquefied natural gas containing methane and heavier hydrocarbon components, in said apparatus there being

(a) supply means to supply said liquefied natural gas to a fractionation column in one or more feed streams; and

(b) a fractionation column connected to said supply means to receive said liquefied natural gas and fractionate it into a more volatile fraction containing a major portion of said methane and a relatively less volatile fraction containing a major portion of said heavier hydrocarbon components;

the improvement wherein said apparatus includes

(1) contacting and separating means operating at a pressure higher than the pressure of said fractionation column, said contacting and separating means including separating means to separate resultant vapors and liquids after contact;

(2) withdrawing means connected to an upper region of said contacting and separating means to withdraw a distillation stream;

(3) first heat exchange means connected to said withdrawing means to receive said distillation stream and cool it sufficiently to partially condense it;

(4) separation means connected to said first heat exchange means to receive said partially condensed distillation stream and separate it into said more volatile fraction containing a major portion of said methane and a reflux stream, said separation means being further connected to said contacting and separating means to supply said reflux stream to said contacting and separating means at a top column feed position;

(5) first heat exchange means further connected to said supply means to receive said liquefied natural gas and heat it, thereby supplying at least a portion of said cooling of said distillation stream;

(6) second heat exchange means connected to receive said heated liquefied natural gas and further heat it sufficiently to vaporize at least a portion of it;

(7) said contacting and separating means connected to receive said further heated liquefied natural gas, whereupon said distillation stream and a liquid stream are formed and separated;

(8) said fractionation column connected to receive said liquid stream and separate it into a vapor stream and said relatively less volatile fraction containing a major portion of said heavier hydrocarbon components;

(9) second heat exchange means further connected to said fractionation column to receive said vapor stream and cool it to substantial condensation;

(10) pumping means connected to said second heat exchange means to receive said substantially condensed stream and pump it to higher pressure;

(11) said second heat exchange means further connected to said pumping means to receive said pumped substantially condensed stream and vaporize at least a portion of it, thereby supplying at least a portion of said cooling of said vapor stream, said second heat exchange means being further connected to said contacting and separating means to supply said at least partially vaporized pumped stream to said contacting and separating means at a lower column feed point; and

(12) control means adapted to regulate the quantity and temperature of said reflux stream and the temperatures of said feed streams to said contacting and separating means and said fractionation column to maintain the overhead

temperatures of said contacting and separating means and said fractionation column at temperatures whereby the major portion of said heavier hydrocarbon components is recovered in said relatively less volatile fraction.

28. In an apparatus for the separation of liquefied natural gas containing methane and heavier hydrocarbon components, in said apparatus there being

(a) supply means to supply said liquefied natural gas to a fractionation column in one or more feed streams; and

(b) a fractionation column connected to said supply means to receive said liquefied natural gas and fractionate it into a more volatile fraction containing a major portion of said methane and a relatively less volatile fraction containing a major portion of said heavier hydrocarbon components;

the improvement wherein said apparatus includes

(1) contacting and separating means operating at a pressure higher than the pressure of said fractionation column, said contacting and separating means including separating means to separate resultant vapors and liquids after contact;

(2) withdrawing means connected to an upper region of said contacting and separating means to withdraw a distillation stream;

(3) first heat exchange means connected to said withdrawing means to receive said distillation stream and cool it sufficiently to partially condense it;

(4) separation means connected to said first heat exchange means to receive said partially condensed distillation stream and separate it into said more volatile fraction containing a major portion of said methane and a reflux stream,

said separation means being further connected to said contacting and separating means to supply said reflux stream to said contacting and separating means at a top column feed position;

(5) first heat exchange means further connected to said supply means to receive said liquefied natural gas and heat it, thereby supplying at least a portion of said cooling of said distillation stream;

(6) second heat exchange means connected to said first heat exchange means to receive said heated liquefied natural gas and further heat it;

(7) dividing means connected to said second heat exchange means to receive said further heated liquefied natural gas and divide it into at least a first stream and a second stream;

(8) third heat exchange means connected to said dividing means to receive said second stream and heat it sufficiently to vaporize at least a portion of it;

(9) said contacting and separating means connected to receive said first stream at a mid-column feed position and said heated second stream at a lower column feed point, whereupon said distillation stream and a liquid stream are formed and separated;

(10) said fractionation column connected to receive said liquid stream and separate it into a vapor stream and said relatively less volatile fraction containing a major portion of said heavier hydrocarbon components;

(11) second heat exchange means further connected to said fractionation column to receive said vapor stream and cool it to substantial condensation;

(12) pumping means connected to said second heat exchange means to receive said substantially condensed stream and pump it to higher pressure;

(13) said second heat exchange means further connected to said pumping means to receive said pumped substantially condensed stream and vaporize at least a portion of it, thereby supplying at least a portion of said cooling of said vapor stream, said second heat exchange means being further connected to said contacting and separating means to supply said at least partially vaporized pumped stream to said contacting and separating means at a lower column feed point; and

(14) control means adapted to regulate the quantity and temperature of said reflux stream and the temperatures of said feed streams to said contacting and separating means and said fractionation column to maintain the overhead temperatures of said contacting and separating means and said fractionation column at temperatures whereby the major portion of said heavier hydrocarbon components is recovered in said relatively less volatile fraction.

29. In an apparatus for the separation of liquefied natural gas containing methane and heavier hydrocarbon components, in said apparatus there being

(a) supply means to supply said liquefied natural gas to a fractionation column in one or more feed streams; and

(b) a fractionation column connected to said supply means to receive said liquefied natural gas and fractionate it into a more volatile fraction

containing a major portion of said methane and a relatively less volatile fraction containing a major portion of said heavier hydrocarbon components;

the improvement wherein said apparatus includes

(1) contacting and separating means operating at a pressure higher than the pressure of said fractionation column, said contacting and separating means including separating means to separate resultant vapors and liquids after contact;

(2) withdrawing means connected to an upper region of said contacting and separating means to withdraw a distillation stream;

(3) first heat exchange means connected to said withdrawing means to receive said distillation stream and cool it sufficiently to partially condense it;

(4) first separation means connected to said first heat exchange means to receive said partially condensed distillation stream and separate it into said more volatile fraction containing a major portion of said methane and a reflux stream, said first separation means being further connected to said contacting and separating means to supply said reflux stream to said contacting and separating means at a top column feed position;

(5) first heat exchange means further connected to said supply means to receive said liquefied natural gas and heat it, thereby supplying at least a portion of said cooling of said distillation stream;

(6) second heat exchange means connected to receive said heated liquefied natural gas and further heat it sufficiently to vaporize at least a portion of it;

(7) said contacting and separating means connected to receive said further heated liquefied natural gas, whereupon said distillation stream and a first liquid stream are formed and separated;

(8) said fractionation column connected to receive said first liquid stream and separate it into a first vapor stream and said relatively less volatile fraction containing a major portion of said heavier hydrocarbon components;

(9) second heat exchange means further connected to said fractionation column to receive said first vapor stream and cool it sufficiently to partially condense it;

(10) second separation means connected to receive said partially condensed first vapor stream and separate it into a second vapor stream and a second liquid stream;

(11) compressing means connected to said second separation means to receive said second vapor stream and compress it to higher pressure, said compressing means being further connected to said contacting and separating means to supply said compressed second vapor stream at a lower column feed point;

(12) pumping means connected to said second separation means to receive said second liquid stream and pump it to higher pressure;

(13) said second heat exchange means further connected to said pumping means to receive said pumped second liquid stream and vaporize at least a portion of it, thereby supplying at least a portion of said cooling of said first vapor stream, said second heat exchange means being further connected to said contacting and

separating means to supply said at least partially vaporized pumped stream to said contacting and separating means at a lower column feed point; and

(14) control means adapted to regulate the quantity and temperature of said reflux stream and the temperatures of said feed streams to said contacting and separating means and said fractionation column to maintain the overhead temperatures of said contacting and separating means and said fractionation column at temperatures whereby the major portion of said heavier hydrocarbon components is recovered in said relatively less volatile fraction.

30. In an apparatus for the separation of liquefied natural gas containing methane and heavier hydrocarbon components, in said apparatus there being

(a) supply means to supply said liquefied natural gas to a fractionation column in one or more feed streams; and

(b) a fractionation column connected to said supply means to receive said liquefied natural gas and fractionate it into a more volatile fraction containing a major portion of said methane and a relatively less volatile fraction containing a major portion of said heavier hydrocarbon components;

the improvement wherein said apparatus includes

(1) contacting and separating means operating at a pressure higher than the pressure of said fractionation column, said contacting and separating means including separating means to separate resultant vapors and liquids after contact;

(2) withdrawing means connected to an upper region of said contacting and separating means to withdraw a distillation stream;

(3) first heat exchange means connected to said withdrawing means to receive said distillation stream and cool it sufficiently to partially condense it;

(4) first separation means connected to said first heat exchange means to receive said partially condensed distillation stream and separate it into said more volatile fraction containing a major portion of said methane and a reflux stream, said first separation means being further connected to said contacting and separating means to supply said reflux stream to said contacting and separating means at a top column feed position;

(5) first heat exchange means further connected to said supply means to receive said liquefied natural gas and heat it, thereby supplying at least a portion of said cooling of said distillation stream;

(6) second heat exchange means connected to said first heat exchange means to receive said heated liquefied natural gas and further heat it;

(7) dividing means connected to said second heat exchange means to receive said further heated liquefied natural gas and divide it into at least a first stream and a second stream;

(8) third heat exchange means connected to said dividing means to receive said second stream and heat it sufficiently to vaporize at least a portion of it;

(9) said contacting and separating means connected to receive said first stream at a mid-column feed position and said heated second stream at a lower

column feed point, whereupon said distillation stream and a first liquid stream are formed and separated;

(10) said fractionation column connected to receive said first liquid stream and separate it into a first vapor stream and said relatively less volatile fraction containing a major portion of said heavier hydrocarbon components;

(11) second heat exchange means further connected to said fractionation column to receive said first vapor stream and cool it sufficiently to partially condense it;

(12) second separation means connected to receive said partially condensed first vapor stream and separate it into a second vapor stream and a second liquid stream;

(13) compressing means connected to said second separation means to receive said second vapor stream and compress it to higher pressure, said compressing means being further connected to said contacting and separating means to supply said compressed second vapor stream at a lower column feed point;

(14) pumping means connected to said second separation means to receive said second liquid stream and pump it to higher pressure;

(15) said second heat exchange means further connected to said pumping means to receive said pumped second liquid stream and vaporize at least a portion of it, thereby supplying at least a portion of said cooling of said first vapor stream, said second heat exchange means being further connected to said contacting and

separating means to supply said at least partially vaporized pumped stream to said contacting and separating means at a lower column feed point; and

(16) control means adapted to regulate the quantity and temperature of said reflux stream and the temperatures of said feed streams to said contacting and separating means and said fractionation column to maintain the overhead temperatures of said contacting and separating means and said fractionation column at temperatures whereby the major portion of said heavier hydrocarbon components is recovered in said relatively less volatile fraction.

31. In an apparatus for the separation of liquefied natural gas containing methane and heavier hydrocarbon components, in said apparatus there being

(a) supply means to supply said liquefied natural gas to a fractionation column in one or more feed streams; and

(b) a fractionation column connected to said supply means to receive said liquefied natural gas and fractionate it into a more volatile fraction containing a major portion of said methane and a relatively less volatile fraction containing a major portion of said heavier hydrocarbon components;

the improvement wherein said apparatus includes

(1) contacting and separating means operating at a pressure higher than the pressure of said fractionation column, said contacting and separating means including separating means to separate resultant vapors and liquids after contact;

(2) withdrawing means connected to an upper region of said contacting and separating means to withdraw a distillation stream;

(3) first heat exchange means connected to said withdrawing means to receive said distillation stream and cool it sufficiently to partially condense it;

(4) first separation means connected to said first heat exchange means to receive said partially condensed distillation stream and separate it into said more volatile fraction containing a major portion of said methane and a reflux stream, said first separation means being further connected to said contacting and separating means to supply said reflux stream to said contacting and separating means at a top column feed position;

(5) first heat exchange means further connected to said supply means to receive said liquefied natural gas and heat it, thereby supplying at least a portion of said cooling of said distillation stream;

(6) second heat exchange means connected to receive said heated liquefied natural gas and further heat it sufficiently to vaporize at least a portion of it;

(7) said contacting and separating means connected to receive said further heated liquefied natural gas, whereupon said distillation stream and a first liquid stream are formed and separated;

(8) said fractionation column connected to receive said first liquid stream and separate it into a first vapor stream and said relatively less volatile fraction containing a major portion of said heavier hydrocarbon components;

(9) second heat exchange means further connected to said fractionation column to receive said first vapor stream and cool it sufficiently to partially condense it;

(10) second separation means connected to receive said partially condensed first vapor stream and separate it into a second vapor stream and a second liquid stream;

(11) compressing means connected to said second separation means to receive said second vapor stream and compress it to higher pressure;

(12) pumping means connected to said second separation means to receive said second liquid stream and pump it to higher pressure;

(13) said second heat exchange means further connected to said pumping means to receive said pumped second liquid stream and vaporize at least a portion of it, thereby supplying at least a portion of said cooling of said first vapor stream;

(14) combining means connected to said compressing means and said second heat exchange means to receive said compressed second vapor stream and said at least partially vaporized pumped stream and form thereby a combined stream, said combining means being further connected to said contacting and separating means to supply said combined stream to said contacting and separating means at a lower column feed point; and

(15) control means adapted to regulate the quantity and temperature of said reflux stream and the temperatures of said feed streams to said

contacting and separating means and said fractionation column to maintain the overhead temperatures of said contacting and separating means and said fractionation column at temperatures whereby the major portion of said heavier hydrocarbon components is recovered in said relatively less volatile fraction.

32. In an apparatus for the separation of liquefied natural gas containing methane and heavier hydrocarbon components, in said apparatus there being

(a) supply means to supply said liquefied natural gas to a fractionation column in one or more feed streams; and

(b) a fractionation column connected to said supply means to receive said liquefied natural gas and fractionate it into a more volatile fraction containing a major portion of said methane and a relatively less volatile fraction containing a major portion of said heavier hydrocarbon components;

the improvement wherein said apparatus includes

(1) contacting and separating means operating at a pressure higher than the pressure of said fractionation column, said contacting and separating means including separating means to separate resultant vapors and liquids after contact;

(2) withdrawing means connected to an upper region of said contacting and separating means to withdraw a distillation stream;

(3) first heat exchange means connected to said withdrawing means to receive said distillation stream and cool it sufficiently to partially condense it;

(4) first separation means connected to said first heat exchange means to receive said partially condensed distillation stream and separate it into said

more volatile fraction containing a major portion of said methane and a reflux stream, said first separation means being further connected to said contacting and separating means to supply said reflux stream to said contacting and separating means at a top column feed position;

(5) first heat exchange means further connected to said supply means to receive said liquefied natural gas and heat it, thereby supplying at least a portion of said cooling of said distillation stream;

(6) second heat exchange means connected to said first heat exchange means to receive said heated liquefied natural gas and further heat it;

(7) dividing means connected to said second heat exchange means to receive said further heated liquefied natural gas and divide it into at least a first stream and a second stream;

(8) third heat exchange means connected to said dividing means to receive said second stream and to heat it sufficiently to vaporize at least a portion of it;

(9) said contacting and separating means connected to receive said first stream at a mid-column feed position and said heated second stream at a lower column feed point, whereupon said distillation stream and a first liquid stream are formed and separated;

(10) said fractionation column connected to receive said first liquid stream and separate it into a first vapor stream and said relatively less volatile fraction containing a major portion of said heavier hydrocarbon components;

(11) second heat exchange means further connected to said fractionation column to receive said first vapor stream and cool it sufficiently to partially condense it;

(12) second separation means connected to receive said partially condensed first vapor stream and separate it into a second vapor stream and a second liquid stream;

(13) compressing means connected to said second separation means to receive said second vapor stream and compress it to higher pressure;

(14) pumping means connected to said second separation means to receive said second liquid stream and pump it to higher pressure;

(15) said second heat exchange means further connected to said pumping means to receive said pumped second liquid stream and vaporize at least a portion of it, thereby supplying at least a portion of said cooling of said first vapor stream;

(16) combining means connected to said compressing means and said second heat exchange means to receive said compressed second vapor stream and said at least partially vaporized pumped stream and form thereby a combined stream, said combining means being further connected to said contacting and separating means to supply said combined stream to said contacting and separating means at a lower column feed point; and

(17) control means adapted to regulate the quantity and temperature of said reflux stream and the temperatures of said feed streams to said

contacting and separating means and said fractionation column to maintain the overhead temperatures of said contacting and separating means and said fractionation column at temperatures whereby the major portion of said heavier hydrocarbon components is recovered in said relatively less volatile fraction.

33. The improvement according to claim 25 wherein a cooling means is connected to said compressing means to receive said compressed vapor stream and cool it, said cooling means being further connected to said contacting and separating means to supply said cooled compressed vapor stream to said contacting and separating means at a lower column feed point.

34. The improvement according to claim 26 wherein a cooling means is connected to said compressing means to receive said compressed vapor stream and cool it, said cooling means being further connected to said contacting and separating means to supply said cooled compressed vapor stream to said contacting and separating means at a lower column feed point.

35. The improvement according to claim 29 wherein a cooling means is connected to said compressing means to receive said compressed second vapor stream and cool it, said cooling means being further connected to said contacting and separating means to supply said cooled compressed second vapor stream to said contacting and separating means at a lower column feed point.

36. The improvement according to claim 30 wherein a cooling means is connected to said compressing means to receive said compressed second vapor stream and cool it, said cooling means being further connected to said contacting and separating

means to supply said cooled compressed second vapor stream to said contacting and separating means at a lower column feed point.

37. The improvement according to claim 31 wherein a cooling means is connected to said compressing means to receive said compressed second vapor stream and cool it, said cooling means being further connected to said combining means to supply said cooled compressed second vapor stream to said combining means and form thereby said combined stream.

38. The improvement according to claim 32 wherein a cooling means is connected to said compressing means to receive said compressed second vapor stream and cool it, said cooling means being further connected to said combining means to supply said cooled compressed second vapor stream to said combining means and form thereby said combined stream.

39. The improvement according to claim 25 wherein a heating means is connected to said fractionation column to receive said vapor stream and heat it, said compressing means is connected to said heating means to receive said heated vapor stream and compress it to higher pressure, and a cooling means is connected to said compressing means to receive said compressed heated vapor stream and cool it, said cooling means being further connected to said contacting and separating means to supply said cooled compressed vapor stream to said contacting and separating means at a lower column feed point.

40. The improvement according to claim 26 wherein a heating means is connected to said fractionation column to receive said vapor stream and heat it, said

compressing means is connected to said heating means to receive said heated vapor stream and compress it to higher pressure, and a cooling means is connected to said compressing means to receive said compressed heated vapor stream and cool it, said cooling means being further connected to said contacting and separating means to supply said cooled compressed vapor stream to said contacting and separating means at a lower column feed point.

41. The improvement according to claim 29 wherein a heating means is connected to said second separation means to receive said second vapor stream and heat it, said compressing means is connected to said heating means to receive said heated second vapor stream and compress it to higher pressure, and a cooling means is connected to said compressing means to receive said compressed heated second vapor stream and cool it, said cooling means being further connected to said contacting and separating means to supply said cooled compressed second vapor stream to said contacting and separating means at a lower column feed point.

42. The improvement according to claim 30 wherein a heating means is connected to said second separation means to receive said second vapor stream and heat it, said compressing means is connected to said heating means to receive said heated second vapor stream and compress it to higher pressure, and a cooling means is connected to said compressing means to receive said compressed heated second vapor stream and cool it, said cooling means being further connected to said contacting and separating means to supply said cooled compressed second vapor stream to said contacting and separating means at a lower column feed point.

43. The improvement according to claim 31 wherein a heating means is connected to said second separation means to receive said second vapor stream and heat it, said compressing means is connected to said heating means to receive said heated second vapor stream and compress it to higher pressure, and a cooling means is connected to said compressing means to receive said compressed heated second vapor stream and cool it, said cooling means being further connected to said combining means to supply said cooled compressed second vapor stream to said combining means and form thereby said combined stream.

44. The improvement according to claim 32 wherein a heating means is connected to said second separation means to receive said second vapor stream and heat it, said compressing means is connected to said heating means to receive said heated second vapor stream and compress it to higher pressure, and a cooling means is connected to said compressing means to receive said compressed heated second vapor stream and cool it, said cooling means being further connected to said combining means to supply said cooled compressed second vapor stream to said combining means and form thereby said combined stream.

45. The improvement according to claim 24 wherein

(1) a dephlegmator is connected to said supply means to receive said liquefied natural gas and provide for the heating of said liquefied natural gas, said dephlegmator being further connected to said fractionation column to receive said distillation stream and cool it sufficiently to partially condense it and concurrently separate it to form said volatile residue gas fraction and said reflux stream, said

dephlegmator being further connected to said fractionation column to supply said reflux stream as a top feed thereto; and

(2) said dividing means is connected to said dephlegmator to receive said heated liquefied natural gas.

46. The improvement according to claim 25, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, or 44 wherein

(1) a dephlegmator is connected to said supply means to receive said liquefied natural gas and provide for the heating of said liquefied natural gas, said dephlegmator being further connected to said contacting and separating means to receive said distillation stream and cool it sufficiently to partially condense it and concurrently separate it to form said volatile residue gas fraction and said reflux stream, said dephlegmator being further connected to said contacting and separating means to supply said reflux stream as a top feed thereto; and

(2) said second heat exchange means is connected to said dephlegmator to receive said heated liquefied natural gas.

47. The improvement according to claim 26 wherein

(1) a dephlegmator is connected to said supply means to receive said liquefied natural gas and provide for the heating of said liquefied natural gas, said dephlegmator being further connected to said contacting and separating means to receive said distillation stream and cool it sufficiently to partially condense it and concurrently separate it to form said volatile residue gas fraction and said reflux stream,

said dephlegmator being further connected to said contacting and separating means to supply said reflux stream as a top feed thereto; and

(2) said dividing means is connected to said dephlegmator to receive said heated liquefied natural gas.